4.2 Previous South Lake Tahoe/Stateline Investigations

4.2.1 UC Davis Institute of Ecology Study (Woodling 1987; Loeb 1987)

Woodling and Loeb conducted a study from January 1986 until February 1987 to characterize the geologic, hydrology, hydraulic and hydrochemical conditions in the South Lake Tahoe groundwater basin. The following paragraphs describe their research and findings, which are presented in detail in their individual documents.

The information gathered was used to assess the magnitude and distribution of the groundwater and nutrient fluxes to Lake Tahoe. The study area was chosen because there was a large base of available data. In addition to using existing information, Woodling and Loeb also collected water samples and aquifer tests as part of their fieldwork. Computer simulation was then used to approximate the flow regime.

Woodling determined that a steady-state flow model could approximate the South Lake Tahoe groundwater basin. Although current studies suggest that South Lake Tahoe has a multiple aquifer system, Woodling's study reported that the aquifer was unconfined based on the specific yield and hydrochemical evidence of the distribution of chemical constituents. Woodling determined the transmissivity was highest at the lakeshore near the center of the valley. The concentrations of nitrate-nitrogen in the groundwater were much higher than in the streams or lake. Soluble reactive phosphorous (SRP) concentrations of groundwater were only slightly higher than in streams and the lake. Woodling's numerical simulation indicated that interflow from the surrounding granitic bedrock is important, and piezometric data suggested that lake water influx to the basin may be possible over a limited area of shoreline.

Woodling and Loeb determined that the annual discharge of groundwater to Lake Tahoe in the study area encompassing Trout Creek and Upper Truckee watersheds to be 1.7×10^6 cubic meters (1,375 acre-feet). The nitrate and soluble reactive phosphorus loading from groundwater was 152.6 kg/yr (336.4 lb/yr) and 26.6 kg/yr (58.6 lb/yr), respectively. This accounted for only 4.6 percent and 1.8 percent of the nitrate and soluble reactive phosphorus loads from the watershed, respectively. Woodling also determined that the high nutrient concentrations of groundwater at the sediment-lake interface may be important in the biological processes of Lake Tahoe. Loeb analyzed further and estimated a range of groundwater loading of nitrate-nitrogen per year to be 153 - 799 kg (337 – 1,760 lbs), representing 5 - 20 percent of the total dissolved inorganic nitrogen loading of Lake Tahoe from this area.

In addition to quantifying the amount of water and associated nutrients entering Lake Tahoe via groundwater, Loeb studied the Upper Truckee and Trout Creek watersheds with the objectives of determining the degree of nutrient contamination of the groundwater, assessing the impact of groundwater inflow on the growth rate of algae in Lake Tahoe, and outlining mitigation measures to prevent further degradation of groundwater quality.

Groundwater sampling indicated that deeper wells had a much lower nitrate-nitrogen concentration than shallow wells in the Trout Creek watershed. Loeb determined that nitrate enters the aquifer from the land surface and does not mix well into the large reservoir of water deep in the aquifer. In addition, a majority of the highest nitrate concentration wells were near the shore. The range of nitrate-nitrogen concentrations were 0.006 – 2.548 mg/L and 0.023 – 1.528 mg/L for Upper Truckee and Trout Creek, respectively. Loeb found that the overall average nitrate-nitrogen concentration for the wells in the Upper Truckee watershed was 0.466 mg/L while phosphorus was found in low to medium concentrations averaging 0.018 mg/L.

The gradient that Loeb observed in the South Lake Tahoe groundwater basin was 0.0028. Transmissivity was taken from earlier studies and further testing was conducted during their study. Loeb determined the distribution of transmissivity correlated closely with sediment thickness. It was found to be highest near the lake in the vicinity of Tahoe Keys and decreased toward the rock boundaries on the east and west. The average transmissivity was 346 m^2/day (3,720 ft^2/day).

Loeb observed a large pumping depression near the confluence of Heavenly Valley Creek and Trout Creek extending north into the Al Tahoe area. Loeb considered the possibility of lake water entering the subsurface due to groundwater pumping, but found that it was not conclusive from the groundwater level data alone.

Loeb recommended mitigation measures to deal with the groundwater nutrient loading to Lake Tahoe. He emphasized the need for educating the local community on how to protect the lake, and that fertilizer use should be held to a minimum and sewer systems should be routinely checked for exfiltration points. He also recommended that the water quality agencies require all public and private water systems to grant permission for water quality sampling for environmental health twice a year. Another suggestion was to restrict land disturbance and sustain a monitoring program to evaluate the trends and provide better information.

4.2.2 Other Investigations

The USGS maintains the most extensive groundwater monitoring network in the South Lake Tahoe/Stateline area. This is mostly due to the extensive basin and groundwater wells available for monitoring. The South Tahoe Public Utility District operates the largest groundwater municipal supply system in the basin. Groundwater supplies 100 percent of the drinking water for the region. The California Tahoe Conservancy, El Dorado County Department of Transportation and local golf courses also provide localized groundwater monitoring networks. These latter systems are typically built for monitoring water quality rather than public supply of drinking water. El Dorado County Environmental Management, the California DHS and Nevada State Health Division (NSHD) also retain limited nutrient data relevant to public drinking water standards. The well construction information for regional wells with nutrient monitoring data is provided in Table 4-2.

Table 4-2. South Lake Tahoe/Stateline Area Well Construction Information

Site No.	Elevation ft above msl	Depth of well, meters
Emerald Bay to Taylor Creek		
027	--	114
041	6,235	30
058	--	14
059	--	59
066	--	12
Subregion 1		
043	6,235	--
047	6,235	11
048	6,235	11
051	6,235	--
052	6,235	--
053	6,235	7
054	6,235	7
055	6,253.58	--
056	6,240	8
057	6,240	8
Subregion 2		
076, 081	--	--
050	6,230	104
083	--	41
084	6,280.92	--
085	6,278	79
086	6,270	--
087	6,276.89	
Subregion 3		
034	6,250	--
039	6,255.37	--
042	6,255	123
044	--	23
045	6,260	38
049	6,268.33	--
Subregion 4		
005, 007, 010, 012, 015, 018, 022-025, 030, 032, 040, 046	--	--
006	--	23
008	--	30
009	--	21
011	6,240	76

Site No.	Elevation ft above msl	Depth of well, meters
013	6,239.48	55
014	6,237.88	--
016	6,230	76
019	6,260	--
020	--	21
021	--	25
026	6,235	43
028	--	32
029	6,250	40
031	6,235	25
033	--	46
035	--	34
036	--	31
037	--	35
038	--	30
Stateline		
001	6,235	2
002	6,235	3
003	6,230	2
004	6,245	7
186	6,320	2
188	6,275	61
193	6,260	8
197	6,235	18
198	6,360	5
199	6,230	3
200	6,230	3
201	6,230	3
202	6,240	4
219	6,335	--

Notes:
1. The source agency code associated with each site number can be found in Appendix A.
2. -- indicates the elevation or well depth is unknown.
3. Data obtained from USGS, LRWQC, CTC, TRPA, El Dorado EM, STPUD, Nevada BHPS, California DHS, California DWR, and Nevada DWR.
4. 1 m = 3.2808 ft

Monitoring data available from agencies date back to 1980. Monitoring of some wells still continues as part of the USGS basin-wide monitoring network and local groundwater monitoring networks. This data is collected to monitor both environmental and public health. See Section 4.3 for a detailed description of the nutrient data.

Groundwater elevations have been recorded periodically as well. These elevations were used in the numerical model for calibration in addition to stream gage elevation data. See Appendix B for a comprehensive report of the groundwater modeling effort.

4.3 Nutrient Concentrations

Groundwater wells are spread throughout the area from Christmas Valley to the Lake shore. The groundwater that is likely to discharge directly to the lake is within 1,500 meters (4,900 ft) of the shoreline. Additionally, groundwater located within 2,000 meters (6,600 ft) directly south of the Tahoe Keys is likely to discharge into the Keys and subsequently into Lake Tahoe. Figure 4-8 shows the flow lines and groundwater contours in the model area. To the south and east of Tahoe Keys, the groundwater tends to travel towards the Upper Truckee River and Trout Creek (Fenske 2003). Because of the extensive monitoring system, this discussion will focus on the wells within the area where groundwater likely discharges directly to the Lake.